

DRAFT RECOVERY PLAN FOR UPLAND SPECIES

**OF THE
SAN JOAQUIN VALLEY, CALIFORNIA**



**Region 1
U.S. Fish and Wildlife Service
Portland, Oregon**

1997



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**Draft Recovery Plan
for Upland Species
of the
San Joaquin Valley, California**

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Portland, Oregon

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1997

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*Drawing of a San Joaquin kit fox by
Kristina Bocchini (based on photo © by
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GUIDE TO RECOVERY PLAN ORGANIZATION

This recovery plan provides individual species accounts for all of the 34 species covered. Recovery strategies are organized by geographic area (or ecosystem area) whenever possible, thereby combining recovery tasks for multiple species. Because of the length and complexity of this recovery plan, an appendix is provided listing the common name and scientific name of all plants and animals mentioned in the plan (Appendix A). Technical terms are italicized and defined at their first use in the text and included in a glossary of technical terms (Appendix B).



DISCLAIMER

Recovery plans delineate reasonable actions that are believed to be required to recover and protect listed species. Plans are published by the U.S. Fish and Wildlife Service, sometimes prepared with the assistance of recovery teams, contractors, State agencies, and others. Objectives will be attained and any necessary funds made available subject to budgetary and other constraints affecting the parties involved, as well as the need to address other priorities. Recovery plans do not necessarily represent the views nor the official positions or approval of any individuals or agencies involved in the plan formulation, other than the U.S. Fish and Wildlife Service. They represent the official position of the U.S. Fish and Wildlife Service *only* after they have been signed by the Regional Director or Director as *approved*. Approved recovery plans are subject to modification as dictated by new findings, change in species status, and the completion of recovery tasks.

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thrasher

EXECUTIVE SUMMARY

Introduction: This recovery plan covers 34 species of plants and animals that occur in the San Joaquin Valley of California. The 11 listed species include 5 endangered plants (California jewelflower, palmate-bracted bird's-beak, Kern mallow, San Joaquin woolly-threads, and Bakersfield cactus), 1 threatened plant (Hoover's woolly-star), and 5 endangered animals (giant kangaroo rat, Fresno kangaroo rat, Tipton kangaroo rat, blunt-nosed leopard lizard, and San Joaquin kit fox). In addition, 23 candidates or species of concern are addressed. The plants include lesser saltscare, Bakersfield smallscale, Lost Hills saltbush, Vasek's clarkia, Temblor buckwheat, Tejon poppy, diamond-petaled California poppy, Comanche Point layia, Munz's tidy-tips, Jared's peppergrass, Merced monardella, Merced phacelia, and oil neststraw; and the animals include Ciervo aegialian scarab beetle, San Joaquin dune beetle, Doyen's dune weevil, San Joaquin antelope squirrel, short-nosed kangaroo rat, riparian woodrat, Tulare grasshopper mouse, Buena Vista Lake shrew, riparian brush rabbit, and San Joaquin LeConte's thrasher.

The majority of these species occur in *arid* grasslands and scrublands of the San Joaquin Valley and the adjacent foothills and valleys. The riparian woodrat and riparian brush rabbit inhabit forested river corridors of the eastern San Joaquin Valley. Conversion of habitat to agricultural, industrial, and urban uses has eliminated these species from the majority of their historic ranges. The remaining natural communities (generally less than 5 percent of historical values) are highly fragmented, and many are marginal habitats in which these species may not persist during catastrophic events such as drought or floods. Moreover, natural communities have been altered permanently by the introduction of nonnative plants, which now dominate in many of the remaining undeveloped areas.

Recovery Objectives: The ultimate goal of this recovery plan is to delist the 11 endangered and threatened species and ensure the long-term conservation of the 23 candidates and species of concern. An interim goal is to reclassify the endangered species to threatened status.

Ecosystem Approach and Community-level Strategy for Recovery: This plan presents both an ecosystem approach to recovery and a community-level

strategy for recovery. The latter is appropriate because most of the listed and candidate species and species of concern co-occur in the same natural communities and are interdependent. By protecting entire communities, the likelihood of successful recovery for listed species is increased, and ensuring the long-term conservation of candidates and species of concern is possible. Of necessity, this community-level strategy is shaped by the realities of existing habitats; available information on biology, distribution, and population statuses of featured species; and the current and anticipated biological and social processes that will affect both remnant natural communities and areas subject to intensive human use, within the human-dominated landscape (i.e., ecosystem) of the San Joaquin Valley.

An ecosystem approach to recovery in the San Joaquin Valley recognizes not only the common origins and interdependencies of the remnant natural communities, but also the fact that the entire region today is a landscape dominated by human activities. Those activities, while defining and shaping the current ecosystem, have often had a fragmenting rather than unifying effect. Thus, recovery also is dependent on the cooperation and collaboration of the various stakeholders, in the Valley ecosystem, which include private landowners, local governments and citizens, and state and Federal agencies.

The six key elements that compose this ecosystem approach and community-level recovery strategy are described below.

1. Recovery criteria

The community-level approach facilitates recovery but does not negate the need to consider the requirements of each species. Thus, individual recovery criteria are presented for each of the 11 species covered by this plan to track their progress towards recovery and to ensure that all of their recovery needs are addressed.

Separate criteria are given in the recovery plan for downlisting 10 species from endangered to threatened, for delisting those 10 species plus 1 threatened species, and for achieving long-term conservation of the 23 featured species that are not currently listed. Elements common to the recovery

criteria of most listed species include:

- protection from development and incompatible uses of the habitat of specified populations representing the full range of genetic and geographic variation in the species,
- development and implementation of appropriate habitat management plans for each species and area identified for protection, and
- self-sustaining status of the specified populations.

The protection strategies for most candidates and species of concern are based on the assumption that if populations remain in habitat remnants throughout a species' historical range, are secure from threats, and are not declining, formal listing will not be necessary.

2. Habitat protection

Considering that habitat loss is the primary cause of species endangerment in the San Joaquin Valley, a central component of species recovery is to establish a network of conservation areas and reserves that represent all of the pertinent terrestrial and riparian natural communities in the San Joaquin Valley. Habitat protection does not necessarily require land acquisition or easement. The most important aspect of habitat protection is that land uses maintain or enhance species habitat values. Elements 4-6 of the recovery strategy address this issue.

Existing natural lands, occupied by the covered species, are targeted for conservation in preference to unoccupied natural land or retired farmland. This greatly reduces or eliminates the need for expensive and untested restoration work to make the land suitable for habitation by these species. Many of the covered species are concentrated in the natural communities that persist in the San Joaquin Valley. The recommended approach is to protect land in large blocks whenever possible. Large blocks minimize edge effects, increase the likelihood that ecosystem functions will remain intact, and facilitate management.

Another recommendation of the plan is that, whenever possible, blocks of conservation lands should be connected by natural land or land with compatible uses to allow for movement of species between blocks. Linkages are proposed both on the

floor of the San Joaquin Valley and in foothills along the margins of the Valley. Few Valley floor linkages exist at this time; restoration of continuous corridors or islands of suitable vegetation that can act as "stepping stones" will be necessary to provide movement corridors. Natural land remaining along the fringes of the San Joaquin Valley will provide both habitat and linkages.

Smaller specialty reserves also are a necessary part of the proposed habitat protection network. They are important for recovery of certain species with highly restricted geographic ranges or specialized habitat requirements. These reserves may be small areas surrounded by developed land, or they may be portions of larger conservation areas that require special management.

3. Umbrella and keystone species

In formulating the community-level strategy, greater emphasis was placed on two groups of species due to their pivotal roles in either conservation (*umbrella species*) or ecosystem dynamics (*keystone species*).

The San Joaquin kit fox occurs in nearly all the natural communities used by other species featured in this plan, but these others are much more restricted in their choice of habitats. The broad distribution and requirement for relatively large areas of habitat means conservation of the kit fox will provide an umbrella of protection for many other species that require less habitat. Therefore, the San Joaquin kit fox is an umbrella species for purposes of this recovery plan. Many of its needs are given higher priority in recovery actions at the regional level (i.e., the ecosystem level) than those of other species because it is one of the species that will be hardest to recover; fulfilling the fox's needs also meets those of many other species.

Protection of keystone species is a high priority because they provide important or essential components of the biological niche of some other listed and candidate species. The giant kangaroo rat and, to a lesser extent, the Fresno, short-nosed, and Tipton kangaroo rats are keystone species in their communities. Burrowing by giant kangaroo rats modifies the surface topography of the landscape and changes the mineral composition of the soil. Their burrows provide refuges and living places for

many small animals, including blunt-nosed leopard lizards and San Joaquin antelope squirrels. The areas over and around their burrows provide a favored microhabitat for the growth of California jewelflower and San Joaquin woolly-threads. Giant kangaroo rats are the most abundant mammal in their community, and are the favored prey of San Joaquin kit foxes and many other predators. The Fresno, short-nosed, and Tipton kangaroo rats have similar but less dramatic roles in their communities.

4. Monitoring and research program

This recovery plan has been developed based on the best scientific information currently available. However, many important aspects of species biology and management have not yet been studied. Thus, continued research, in conjunction with *adaptive management* (element #5), is a crucial component of this plan. Recovery criteria and tasks must be reevaluated for each species as research is completed.

Primary information needs for the species featured in this plan and the ecosystem as a whole are:

- habitat management research,
- habitat and species restoration trials,
- surveys to determine species distributions,
- biosystematic and population genetics studies,
- reproductive and *demographic* studies,
- population censusing and monitoring, and
- studies of pesticide effects on the featured species and their associated species.

5. Adaptive management

In most cases, active management of the land is necessary to maintain and enhance species habitat values. However, management strategies have not been investigated for most species. Management research (element #4) may take many years to complete, while listed species populations continue to decline. The only practical approach is adaptive management, where some type of management is applied, population responses are monitored, the outcome is evaluated, and management is readjusted accordingly. This process should continue until definitive research is completed or self-sustaining populations are achieved. Unless scientific data or credible evidence point to the contrary, the

recommended initial management strategy for each area that is occupied by listed species is to continue existing land uses at current levels.

6. Economic and social considerations

This plan proposes six tactics to reduce the costs of recovery, the impact of recommended actions on the local economy, and the constraints placed on citizens of the San Joaquin Valley:

- Focusing recovery, to the maximum extent possible, on lands already in public or conservation ownership,
- Encouraging continuation of traditional land uses, such as seasonal livestock grazing, oil production, hunting, and wildland recreation, when compatible with listed species management needs,
- Targeting agricultural land that must be retired, due to drainage problems or lack of irrigation water, for restoration to provide linkages or additional habitat for listed species,
- Developing a safe harbor program as an incentive for landowners to maintain or create endangered species habitat on their property,
- Developing other positive incentives, especially economic, for conservation, and
- Tying, as closely as possible, the habitat protection network to local and regional conservation planning efforts, including habitat conservation plans.

Implementation Participants: Although the U.S. Fish and Wildlife Service has the statutory responsibility for implementing this recovery plan, and only Federal agencies are mandated to take part in the effort, the participation of a variety of groups, in both initial plan implementation and the subsequent adaptive management process, is essential to successful recovery. Thus, the plan recommends the establishment of a regional, cooperative public/private recovery plan implementation team to enlist the participation of all stakeholder groups and interested parties. This group would develop a participation plan, coordinate education and outreach efforts, including community participation in research and information gathering when appropriate, assist in developing economic incentives for conservation and recovery, ensure that adaptive management is practiced, and define other recovery and management tasks as necessary.

Total Estimated Cost of Recovery¹:

Priority 1 tasks: \$101,570,000

Priority 2 tasks: \$21,459,000

Priority 3 tasks: \$2,850,000

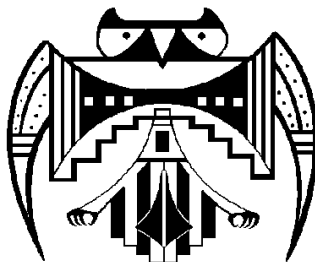
There are likely to be additional costs that are yet to be determined.

Date of Recovery: Because recovery is defined in relation to a climatological cycle for most species covered in this recovery plan, the date of recovery is anticipated for most listed species to be approximately 20 years.

¹ Priority 1—An action that must be taken to prevent extinction or prevent the species from declining irreversibly in the foreseeable future.

Priority 2—An action that must be taken to prevent a significant decline in species population or habitat quality, or some other significant negative impact short of extinction.

Priority 3—All other actions necessary to meet the recovery objectives.



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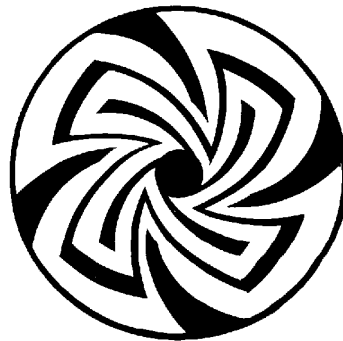


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I. INTRODUCTION

The San Joaquin and Sacramento Valleys together form the great Central Valley of California, an enormous flat-bottomed trench rimmed by mountains (Figure 1). The Valley floor is 690 kilometers (430 miles) long and covers about 6,070,310 hectares (15 million acres). The San Joaquin Valley's watershed encompasses approximately 20 percent of the land area of the State (Colliver 1993). Its floor below about the 152-meter (500-foot) contour measures approximately 3.44 million hectares (8.5 million acres) and extends about 415 kilometers (258 miles) north-south. West of the Valley proper, hills below about 915 meters (3,000 feet) and high plains support natural communities in common with much of the Valley floor.

The San Joaquin Valley floor is occupied by four urban areas each with populations numbering from 200,000 to more than 500,000 people—Stockton, Modesto, Fresno, and Bakersfield—and eight smaller urban centers each with between 50,000 and 150,000 people: Lodi, Tracy, Manteca, Turlock, Merced, Madera, Hanford-Lemoore, and Visalia. By 1979, nearly all the Valley floor and many of the flatter upland areas were urbanized or converted to cultivated cropland. Less than 60,700 hectares (150,000 acres) on the Valley floor remains uncultivated. Most of the remaining undeveloped land is in the foothills on the Valley's perimeter. Significant portions of the land not cultivated or urbanized have been developed for petroleum extraction, strip-mined for gypsum and clay, or occupied by roads, canals, airstrips, oil-storage facilities, pipelines, and evaporation and percolation basins.

A. OVERVIEW

1. Species Represented and Biotic Communities

Listed Species.—This recovery plan covers 11 species federally-listed as endangered or threatened (Table 1). Five plants *endemic* to arid shrublands and grassland communities of the San Joaquin Valley are endangered or threatened. Of the five, the California jewelflower occupied a wide range of elevation and community types, but is now very restricted in distribution. Bakersfield cactus is the only desert-adapted succulent plant within the San Joaquin Biotic Region (Williams and Kilburn 1992). A sixth

endangered plant covered in this recovery plan, palmate-bracted bird's beak, mostly occupies alkali sink and chenopod scrub communities; its range extends into similar communities in the Sacramento Valley.

Of the five federally endangered species of animals included in this recovery plan, two species have formerly-approved recovery plans. A recovery plan for the blunt-nosed leopard lizard was approved in 1980 (U.S. Fish and Wildlife Service [USFWS] 1980a) and a revised recovery plan was approved in 1985 (USFWS 1985a). The San Joaquin kit fox recovery plan was approved in 1983 (O'Farrell 1983). Thus, this recovery plan represents a revision of the recovery plans for these two species.

Of these 11 federally-listed plant and animal species, critical habitat has been designated only for the Fresno kangaroo rat. See the species account for the Fresno kangaroo rat for a description of its critical habitat.

Associated Candidates and Species of Concern.—

Thirteen plant species of concern that occur in desert scrub, grassland, and seasonal *playa* habitats with existing geographic ranges within the region are fully considered in this recovery plan (Table 1). Three mammals that are candidates for Federal listing, and four species of concern also are featured in this recovery plan (Table 1). The Buena Vista Lake shrew is the only species to be included that was historically most common in wetlands. It is included here because all of its extant habitat and potential habitat is included within the habitats of the listed species that use alkali sink and associated communities. Two riparian species also are included, the riparian brush rabbit and riparian woodrat. Though their habitats are distinct from those of the other featured species, they are the only two riparian species whose ranges are confined to the San Joaquin Valley. It was expedient to include them here. Three insect species of concern confined to interior sand dune communities and loose sandy soils in other grassland and shrubland communities also are featured in this plan (Table 1). Approximately 61 other plants of concern have geographic distributions partly or wholly within the San Joaquin Valley planning region, but either are confined to wetlands and vernal pools or range into the Sierra Nevada foothills or Delta and East Bay Regions at the north end of the Valley, and are not covered by this plan.

**TABLE 1. Federally-Listed Species, Candidates and Species of Concern
Included in this Recovery Plan.**

| Species | Status ^a | Recovery Priority ^b | Federal Listing Date & Reference; State Listing Date | Community Associations |
|---|---------------------|--------------------------------|---|--|
| California jewelflower (<i>Caulanthus californicus</i>) | FE, CE | 2 | 19 Jul 1990, 55 Fed. Reg. 29370; Jan 1987 | grasslands, subshrub scrub, chenopod scrub, juniper woodland |
| palmate-bracted bird's-beak (<i>Cordylanthus palmatus</i>) | FE, CE | 2c | 31 Jul 1986, 51 Fed. Reg. 23765, May 1984 | Valley and foothill grasslands, chenopod scrub |
| Kern mallow (<i>Eremalche kernensis</i>) | FE | 2 | 19 Jul 1990, 55 Fed. Reg. 29370 | chenopod scrub, grassland |
| Hoover's woolly-star (<i>Eriastrum hooveri</i>) | FT | 2 | 19 Jul 1990, 55 Fed. Reg. 29370 | chenopod scrub, grassland |
| San Joaquin woolly- threads (<i>Lembertia congdonii</i>) | FE | 2 | 19 Jul 1990, 55 Fed. Reg. 29370 | grassland, chenopod scrub, subshrub scrub |
| Bakersfield Cactus (<i>Opuntia basilaris</i> var. <i>treleasei</i>) | FE, CE | 2 | 19 Jul 1990, 55 Fed. Reg. 29370; Jan 1990 | sandy soils, arid grassland, chenopod scrub |
| giant kangaroo rat (<i>Dipodomys ingens</i>) | FE, CE | 2c | 5 Jan 1987, 52 Fed. Reg. 283; 2 Oct 1980 | grassland, chenopod scrub, subshrub scrub |
| Fresno kangaroo rat (<i>Dipodomys nitratoides exilis</i>) | FE, CE | 3c | 30 Jan 1985, 50 Fed. Reg. 4222; 27 June 1971(rare), 2 Oct 1980 (endangered) | Relictual Interior Dune Grassland, other grasslands, chenopod scrub, alkali sink |
| Tipton kangaroo rat (<i>Dipodomys nitratoides nitratoides</i>) | FE, CE | 2c | 8 Jul 1988, 53 Fed. Reg. 25608; 11 Jun 1989 | Relictual Interior Dune Grassland, chenopod scrub, alkali sink, other grasslands |
| blunt-nosed leopard lizard (<i>Gambelia sila</i>) | FE, CE | 3c | 11 Mar 1967, 32 Fed. Reg. 4001; 27 Jun 1971 | grassland, chenopod scrub, alkali sink, subshrub scrub |
| San Joaquin kit fox (<i>Vulpes macrotis mutica</i>) | FE, CT | | 11 Mar 1967, 32 Fed. Reg. 4001; 27 Jun 1971 | grasslands, chenopod scrub, alkali sink, subshrub scrub, oak woodland, agriculture |
| lesser saltscale (<i>Atriplex minuscula</i>) | SC | | | chenopod scrub, grassland, alkaline playas |
| Bakersfield smallscale (<i>Atriplex tularensis</i>) | SC, CE | | Jan 1987 | alkali sink, chenopod scrub |
| Lost Hills saltbush (<i>Atriplex vallicola</i>) | SC | | | alkali sink, chenopod scrub |
| Vasek's clarkia (<i>Clarkia tembloriensis</i> ssp. <i>calientensis</i>) | SC | | | Valley and foothill grassland |
| Temblor buckwheat (<i>Eriogonum temblorense</i>) | SC | | | barren clay, shale soils, grassland, subshrub scrub |
| Tejon poppy (<i>Eschscholzia lemmonii</i> ssp. <i>kernensis</i>) | SC | | | grasslands |
| diamond-petaled California poppy (<i>Eschscholzia rhombipetala</i>) | SC | | | clay soils, grasslands |
| Comanche Point layia (<i>Layia leucopappa</i>) | SC | | | chenopod scrub, grasslands |
| Munz's tidy-tips (<i>Layia munzii</i>) | SC | | | alkaline clay soils, grasslands, chenopod scrub |

TABLE 1 (continued). Federally-Listed Species, Candidates and Species of Concern Included in this Recovery Plan.

| Species | Status ^a | Recovery Priority ^b | Federal Listing Date & Reference; State Listing Date | Community Associations |
|--|---------------------|--------------------------------|--|---|
| Jared's peppergrass (<i>Lepidium jaredii</i>) | SC | | | alkali sink, grasslands, chenopod scrub |
| Merced monardella (<i>Monardella leucocephala</i>) | SC | | | sandy soils, grasslands |
| Merced phacelia (<i>Phacelia ciliata</i> var. <i>opaca</i>) | SC | | | clay soils, grasslands |
| oil neststraw (<i>Stylocline citroleum</i>) | SC | | | clay soils, chenopod scrub |
| Ciervo aegialian scarab beetle (<i>Aegialia concinna</i>) | SC | | | Relictual Interior Dune Grassland, chenopod scrub in sandy soil |
| San Joaquin dune beetle (<i>Coelus gracilis</i>) | SC | | | Relictual Interior Dune Grassland, chenopod scrub |
| Doyen's dune weevil (<i>Trigonoscuta</i> sp.) | SC | | | Relictual Interior Dune Grassland, chenopod scrub |
| San Joaquin antelope squirrel (<i>Ammospermophilus nelsoni</i>) | SC, CT | | 2 Oct 1980 | grassland, chenopod scrub, subshrub scrub, alkali sink |
| short-nosed kangaroo rat (<i>Dipodomys nitratoides brevinasus</i>) | SC | | | grassland, chenopod scrub, subshrub scrub, alkali sink |
| riparian woodrat (<i>Neotoma fuscipes riparia</i>) | C | | | riparian forest and scrub |
| Tulare grasshopper mouse (<i>Onychomys torridus tularensis</i>) | SC | | | grassland, chenopod scrub, subshrub scrub, alkali sink |
| Buena Vista Lake shrew (<i>Sorex ornatus relictus</i>) | C | | | marsh, riparian |
| riparian brush rabbit (<i>Sylvilagus bachmani riparius</i>) | C, CE | | 29 Apr 1994 | riparian forest and scrub |
| San Joaquin LeConte's thrasher (<i>Toxostoma lecontei macmillanoura</i>) | SC | | | chenopod scrub, subshrub scrub |

^a FE & FT—Federal Endangered and Threatened; CE & CT—California Endangered and Threatened; C—Federal candidates for listing; SC—species of concern (species not presently candidates for listing) (USFWS 1996).

^b Recovery Priority—
See Appendix C for how recovery priorities are established for listed species.



Biotic Communities.—Major types of natural plant communities in the San Joaquin Valley below the 500-meter (1,640-foot) contour include herbaceous (grasslands, vernal pools, and marshes), shrublands, woodlands, and riparian forests (Figure 2; Küchler 1977, Holland 1986, Griggs et al. 1992). Above that elevation, vegetation grades through woodlands and into evergreen forests. On the west, grassland and shrub communities extend to between 610 and 915 meters (2,000 and 3,000 feet).

Although biotic communities comprise both animals and plants, communities typically are named on the basis of the dominant plant species or site characteristics. Several classification systems have been proposed for biotic communities in California, but none is universally accepted. Specific community names that are capitalized herein correspond to those described by Holland (1986) and Griggs et al. (1992). The equivalent names under alternate systems are summarized by Mayer and Laudenslayer (1988). Many of the natural communities in the San Joaquin Valley are considered rare (Holland 1986, Griggs et al. 1992), irrespective of the presence of rare species. Certain recovery actions for endangered and threatened species also will contribute to the conservation of the rare communities they inhabit. Plant communities discussed in this recovery plan are described below. **See Table 1 for the featured species that occur in these plant communities.**

Grasslands are dominated by perennial or annual grasses, but the associated *forbs* (broad-leaved herbs) often are conspicuous because of their showy flowers. General terms that have been used for grasslands in the San Joaquin Valley include California prairie (Küchler 1977) and Valley and Foothill Grassland (Holland 1986). The featured species in this recovery plan occur in the following grassland communities: Nonnative Grassland, Pine Bluegrass Grassland, Relictual Interior Dune Grassland, Valley Needlegrass Grassland, and Valley Sacaton Grassland. Some of the featured species may range through areas that consist of a mosaic of grasslands and vernal pools, particularly Northern Claypan Vernal Pools and Northern Hardpan Vernal Pools.

A marsh is an herbaceous wetland community. The dominant plants (sedges, rushes, and cattails) are related to grasses. A general name for freshwater marshes of the San Joaquin Valley is tule marsh (Küchler 1977), which includes Cismontane Alkali Marsh, Valley Freshwater Marsh, and Vernal Marsh. Valley Freshwater Marsh

intergrades with Coastal Brackish Marsh in the Sacramento-San Joaquin Delta.

San Joaquin Valley shrublands often are referred to as *scrub* because they are dominated by shrubs less than 2 meters (6 feet) tall. In scrub communities the actual cover of shrubs may be dense or sparse, and the ground cover often consists of grasses and forbs typical of grassland communities. In the San Joaquin Valley, scrubs occur in alkali sinks, on alluvial fans, on dune remnants, in riparian areas, and in arid uplands.

Alkali sinks are drainage basins that have soils high in soluble salts, which may or may not be alkaline (Twisselmann 1967). These basins are dominated by *halophytes*, i.e., plants tolerant of alkaline and saline soils. *Playas* (shallow, temporary lakes) may form in alkali sinks during periods of heavy rainfall. Alkali sinks in the San Joaquin Valley typically support scrub plant communities such as Alkali Playa, *Haplopappus* Shrubland, and Valley Sink Scrub.

Alluvial fans are fan-shaped areas of soil deposited by mountain streams where they enter valleys or plains. In the San Joaquin Valley, alluvial fans typically support saltbush scrub, which is one of several plant assemblages dominated by common saltbush (*Atriplex polycarpa*) or spiny saltbush (*A. spinifera*). These include Interior Coast Range Saltbush Scrub, Sierra-Tehachapi Saltbush Scrub, and Valley Saltbush Scrub. A type of saltbush scrub also may occur on sandy deposits surrounding historical lake beds, where it is termed the Relictual Interior Dunes community. *Chenopod* scrub is a general term for shrublands that are dominated by plants in the goosefoot family (Chenopodiaceae); in the San Joaquin Valley this includes the various saltbush scrubs, Alkali Playa, and Valley Sink Scrub. Alkali Meadow is a transitional community that occurs at the bottom of alluvial fans; it comprises a mixture of species characteristic of alkali sinks, grasslands, marshes, and riparian forests.

Riparian scrubs occur along rivers and streams and may intergrade with riparian forests. The general name Great Valley Riparian Scrub includes several community types dominated by different shrub species, including Buttonbush Scrub, Elderberry Savanna, Great Valley Mesquite Scrub, and Great Valley Willow Scrub. Intermittent Stream Channels also are riparian but have a different shrub composition than do the channels of permanent streams.

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Other scrubs that occur in arid upland areas of the San Joaquin Valley and adjacent high plains include Upper Sonoran Subshrub Scrub and chaparrals. *Subshrubs* are perennial plants that are woody only at the base, such as California buckwheat (*Eriogonum fasciculatum*) and matchweed (*Gutierrezia californica*). However, Upper Sonoran Subshrub Scrub also includes true shrubs such as California ephedra (*Ephedra californica*) and bladderpod (*Isomeris arborea*). Chaparrals are characterized by evergreen shrubs and occur most often in the outer coast ranges. Small patches have been mapped in the hills surrounding the San Joaquin Valley (Küchler 1977), but none provide habitat for the featured species in this recovery plan.

Both woodlands and forests are dominated by trees. However, trees are spaced more distantly in woodlands than in forests. Woodlands are characteristic of the foothills surrounding the San Joaquin Valley and also occur in the transition zones between riparian forest and grassland. Woodlands may be named on the basis of the most common trees (e.g., oak woodland, juniper woodland) or on their location (e.g., foothill woodlands, riparian woodlands). *Cismontane* woodlands are those that occur west of the Sierra Nevada crest. Woodlands in the region covered by this recovery plan include Blue Oak Woodland, Cismontane Juniper Woodland and Scrub, and Valley Oak Woodland.

Forests in the Great Central Valley consist of broad-leaved, deciduous trees and occur along rivers and streams. Shrubs, vines, and tree seedlings typically create a dense understory. A general term for this forest type is Valley riparian forest. Specific community names include Great Valley Cottonwood Riparian Forest, Great Valley Mixed Riparian Forest, and Great Valley Valley Oak Riparian Forest.

Any division of vegetation into community types must be somewhat arbitrary because communities often intergrade, rather than having identifiable boundaries. The intergradation of plant communities leads to some discrepancies regarding their proper classification. Thus, Holland (1986) included Alkali Meadow and Alkali Playa with the herbaceous communities even though both include shrubs. He classified Great Valley Mesquite Scrub as a riparian plant community, but Twisselmann (1967) considered it to be characteristic of alkali sinks. Communities also may occur in *mosaics*, which are interspersed patches of vegetation dominated by different species. Plants and animals may be

restricted to particular *microhabitats*, which are localized areas with unique conditions due to small-scale variations in topography, soil characteristics, drainage patterns, and other physical features of the landscape. Thus, habitat descriptions for the rare and endangered species in this recovery plan are to some extent generalizations, which take into account the range of communities in which each species occurs.

The San Joaquin Valley shares much of its unique biota with the Sacramento Valley. Most of the Central Valley's *endemism* (species restricted in occurrence) is associated, in order of numbers, with extreme aridity, vernal pools, and wetlands. Among vascular plants, endemism is mostly associated with vernal pools (14 species), extreme aridity (8 species), and alkaline soils (6 or more species). Of the 44 endemic plants of the Central Valley, 26 are shared by the two regions, 14 are San Joaquin Valley endemics, and only 4 are confined to the Sacramento Valley. Of the 28 species and subspecies of endemic mammals, reptiles, and amphibians in the Central Valley, 16 are associated with arid grassland and shrubland communities in the San Joaquin Valley, and only 3 are confined to the Sacramento Valley (Bradford 1992, Williams and Kilburn 1992). More endemic vertebrate species co-occur in the San Joaquin Valley than anywhere comparable in the continental United States.

2. Reasons for Decline and Threats to Communities

Loss and degradation of natural communities due to agriculture, urbanization, livestock grazing, water impoundment and diversion, nonspecific predator and pest control, and other human activities have jeopardized nearly all the unique biota of the Valley below the woodland belts, and are the major causes of endangerment of the state and federally listed species (Figure 3). The delta freshwater marshes and the vast tule marshes of the Valley are nearly gone. Of the approximately 2,110,257 hectares (5,214,539 acres) of land in the southern San Joaquin Valley region (including the Carrizo Plain Natural Area and most of the Tulare Basin below the woodland belts) studied by the California Energy Commission, only 324 hectares (800 acres) of degraded wetlands were found by 1989 (Spiegel and Anderson 1992). A few thousand acres of seasonal wetlands are still found farther north in the San Joaquin Basin, mostly in Fresno and Merced Counties. The grassland and vernal pool communities have been reduced mostly to narrow piedmont strands, fringing the

Valley floor, and their native species have been largely displaced by exotic species of weedy annual grasses and forbs. Of the original 404,700 hectares (about 1 million acres) or more of riparian communities in the Central Valley, less than 10 percent existed in 1979, mostly located in the Sacramento Valley (Warner 1979). Water diversions, stream channelization, and clearing and cultivation of riparian communities all have played roles in loss of riparian communities. Of those remaining today, most are highly degraded in quality and support few or none of their characteristic species. Extant riparian communities in the San Joaquin Valley consist of less than 2,800 hectares (6,989 acres) of narrow, degraded stands along channelized streams. Only about 269 hectares (665 acres) of relatively mature riparian forest with a well-developed understory of herbs and shrubs are found in two parks and one preserve in the San Joaquin Valley (Williams and Kilburn 1984).

Loss and degradation of natural communities in the region due to conversion to irrigated cropland have continued at much slower rates since about 1986, but still pose new threats to many additional species (Williams and Kilburn 1992, USFWS 1994a). The greatest new threats are to the biota of grassland and vernal pool communities along the eastern and northwestern edges of the Valley, where urbanization, ranchette developments, wind energy developments, and cultivation are collectively causing destruction of natural communities at an increasing pace.

3. Conservation Efforts at the Community Level

Past Conservation Measures.—Specific and important general conservation measures for one or a few species are briefly mentioned in individual species accounts. Highlighted here and in Table 2 are the most significant large-scale natural community acquisitions and habitat conservation planning efforts involving the species covered in this document. The California Energy Commission has conducted two important large-scale natural community and species surveys. The first was The Southern San Joaquin Valley Ecosystem Protection Program (Anderson et al. 1991, Spiegel and Anderson 1992), wherein surveys of quarter-sections of natural lands in most of the Tulare Basin were made. Later, California Energy Commission conducted quarter-section surveys on the Carrizo Plain Natural Area with funding provided by the U.S. Bureau of Land Management (USBLM; Kakiba-Russell et al. in litt. 1991). These two programs have collectively provided

more information on extant biotic communities and habitat distribution and quality for listed species than all others combined. The California Energy Commission's Southern San Joaquin Ecosystem Protection Plan (Spiegel and Anderson 1992) has provided the framework on which the resource management agencies have developed their mitigation and conservation strategies.

Seven wide-area multispecies (i.e., community level involving thousands of acres) Habitat Conservation Plans are in various stages of development in the San Joaquin Valley as conditions of incidental-take permits under section 10 of the Endangered Species Act of 1973 (P.L. 93-205, 16 U.S.C. 1531 et seq.). Under section 10(a)(1)(B) of the Endangered Species Act, the USFWS can authorize the taking of federally listed fish and wildlife by nonfederal entities if such taking occurs incidentally during otherwise legal activities. An applicant for an incidental take permit must submit a Habitat Conservation Plan that specifies, among other things, the impacts that are likely to result from the takings and the measures the permit applicant will undertake to minimize and mitigate such impacts. The Metropolitan Bakersfield Habitat Conservation Plan has been implemented, and the Kern Valley floor, Tulare, and San Joaquin Counties Habitat Conservation Plans are in active development stages. The Pleasant Valley Habitat Conservation Plan has been suspended by Fresno County. The other large conservation efforts in the Valley include the Carrizo Natural Heritage Program (USBLM, California Department of Fish and Game [CDFG], The Nature Conservancy), California Energy Commission mitigation programs, the CDFG mitigation program in the Allensworth Natural Area (Spiegel and Anderson 1992), and endangered species habitat protection programs on the Elk Hills Naval Petroleum Reserves in California (Department of Energy and Kern and Pixley National Wildlife Refuges (Table 2), and the National Wildlife Refuge programs (Kern and San Luis refuge complexes). Several mitigation banks, (i.e., large blocks of land preserved, restored and enhanced for purposes of consolidating mitigation for and mitigating in advance for projects that take listed species) are part of existing or developing Habitat Conservation Plans in the San Joaquin Valley. These include the ARCO Cole's Levee and Chevron Lokern Habitat Conservation Plans, both in Kern County.

Appropriations from Congress and money provided by the California Wildlife Conservation Board and raised

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TABLE 2. Summary of Larger and Community-level Conservation Efforts in the San Joaquin Valley Planning Area.

| Project | Purpose | Location | Mgmt. Agency ^a | Target Species ^b | Other Species | Size (Acres) | Year Acquired |
|---------------------------------------|---------------|------------------------------|---------------------------|-----------------------------|-------------------|--------------|---------------|
| T & E purchase | nonmitigation | Alkali Sink ER | CDFG | bnll fkr | pbbb hws | 930 | 1978-85 |
| T & E purchase | nonmitigation | Kerman ER | CDFG | bnll fkr | bss lhsb | 1,775 | 1987-88 |
| T & E purchase | nonmitigation | Panoche Hills ER | CDFG | bnll gkr sjkf | | 595 | 1985 |
| T & E purchase | nonmitigation | Buttonwillow | CDFG | bnll sjas sjkf tkr | hws | 1,350 | 1991 |
| T & E purchase | nonmitigation | Allensworth ER | CDFG | bnll sjkf tkr | | 2,924 | 1980-95 |
| T & E purchase | nonmitigation | Pixley Conservation Easement | KNWR | bnll tkr | | 10 | ?? |
| Carrizo NA-CDFG | nonmitigation | Carrizo Plain Natural Area | CDFG | bnll gkr sjas sjkf | sjwt | 6,060 | 1988-89 |
| Carrizo NA-TNC | nonmitigation | Carrizo Plain Natural Area | TNC | bnll gkr sjas sjkf | lhsb | 7,428 | 1987 |
| Lokern-TNC | nonmitigation | Lokern | CNLM | bnll gkr sjas sjkf | hws km lhsb | 2,047 | 1993-94 |
| Sand Ridge | nonmitigation | Sand Ridge | TNC | bc | sjwt tkr | 285 | ?? |
| Semitropic Ridge-TNC | nonmitigation | Semitropic Ridge | CNLM | bnll tkr sjas sjkf | cjf hws sjwt lhsb | 598 | 1993 |
| Pixley NWR | nonmitigation | Pixley NWR | USFWS | bnll tkr sjas sjkf | | 1,244 | ?? |
| CEC Sycamore Cogeneration | mitigation | Semitropic Ridge | CEC | sjkf tkr | | 1,924 | 1988-92 |
| Misc. mitigations less than 100 acres | mitigation | Semitropic Ridge | CEC | sjkf tkr | | 311 | 1988-92 |
| CEC Midway/Sunset Cogen. | mitigation | Lokern | CEC | bnll gkr sjkf | | 883 | 1989-92 |
| Misc. mitigation less than 150 acres | mitigation | Lokern | CEC | bnll gkr sjkf | | 284 | 1989-91 |
| Metro Bakersfield HCP | mitigation | Coles Levee EP | CLEP | bnll gkr sjas sjkf tkr | hws | 2,000 | 1992 |
| Metro Bakersfield HCP | mitigation | Elk Hills | CDFG | bnll gkr sjas sjkf | | 515 | 1994 |
| Hollister Resource Area | nonmitigation | Panoche Hills | USBLM | bnll gkr sjkf | hws jpg sjwt | 26,412 | ?? |
| Hollister Resource Area | nonmitigation | Griswold/Tumey Hills | USBLM | gkr sjkf | jpg | 51,461 | ?? |
| Hollister Resource Area | nonmitigation | Ciervo Hills/Joaquin Rocks | USBLM | bnll gkr sjdb sjkf | jpg | 23,711 | ?? |
| Hollister Resource Area | nonmitigation | Coalinga | USBLM | bnll sjkf | cjf | 14,660 | ?? |
| Caliente Resource Area | mitigation | Elk Horn Plain | USBLM | bnll gkr sjkf | hws sjwt tbw | 160 | 1983 |
| CVP CA Aqueduct | mitigation | CA Aqueduct/Region 4 | CDFG | bnll gkr sjkf tkr | bc hws sjwt | 115 | 1975 |

TABLE 2. (continued). Summary of Larger and Community-level Conservation Efforts in the San Joaquin Valley Planning Area.

| Project | Purpose | Location | Mgmt. Agency | Target Species ² | Other Species | Size (Acres) | Year Acquired |
|------------------------------------|------------|--------------------------------|--------------|-----------------------------|---------------------------|--------------|---------------|
| Coalinga Gravel Operation | mitigation | Semitropic Ridge | CDFG | bnll sjkf | | 200 | 1993 |
| McKittrick Lateral | mitigation | Lokern | CDFG | bnll sjas sjkf | | 60 | 1993 |
| Caliente RA-Interim Grazing Plan | mitigation | Carrizo Natural Area | USBLM | bnll gkr sjas sjkf snkr | cjf hws lhsb jpg mtt sjwt | 103,102 | 1988 |
| Coalinga Cogeneration | mitigation | Pleasant Valley | CDFG | bnll sjkf | | 316 | 1991 |
| Fiber-Optic Cable | mitigation | Lokern | CDFG | bnll sjas sjkf | | 267 | 1993 |
| PGE/PGT Pipeline | mitigation | Jasper Sears Mitigation Parcel | CDFG | sjkf | | 160 | 1992 |
| PGE/PGT Pipeline | mitigation | Palm Tract | CDFG | sjkf | | 1,076 | 1994 |
| PGE/PGT Pipeline | mitigation | Tracy Hills | CDFG | sjkf | | 443 | 1993 |
| Safeway/Patterson Pass | mitigation | Tracy Hills | CDFG | sjkf | | 627 | 1992 |
| PG&E Stan Pac II & Stockdale Ranch | mitigation | Allensworth ER | CDFG | bnll sjkf tkr | sjas | 126 | 1991 |
| CSU Bakersfield | mitigation | Allensworth ER | CDFG | bnll sjkf tkr | sjas | 20 | 1991 |
| Delano Prison | mitigation | Allensworth ER | CDFG | bnll sjkf tkr | sjas | 106 | 1991 |
| Oceanic Communities Dev | mitigation | Allensworth ER | CDFG | bnll sjkf tkr | sjas | 120 | 1991 |
| Delano Prison | mitigation | Allensworth ER | CDFG | bnll sjkf tkr | sjas | 530 | 1991 |
| Oceanic Communities Dev | mitigation | Allensworth ER | CDFG | bnll sjkf tkr | sjas | 272 | 1992 |
| CSU Bakersfield | mitigation | Allensworth ER | CDFG | bnll sjkf tkr | sjas | 40 | 1991 |
| Badger Creek Limited | mitigation | Allensworth ER | CDFG | bnll sjkf tkr | sjas | 30 | 1992 |
| McKittrick Limited | mitigation | Allensworth ER | CDFG | bnll sjkf tkr | sjas | 18 | 1992 |
| PG&E Line #2 Gas Replacement | mitigation | Allensworth ER | CDFG | sjkf | | 36 | 1995 |
| Laidlaw Pipeline | mitigation | Lokern | TNC | bnll km sjkf | | 3 | 1993 |
| Kettleman Hills Waste Fac. | mitigation | Semitropic | TNC | sjkf | | 80 | 1993 |
| PSE inc. | mitigation | Carrizo Plains Natural Area | USBLM | bnll sjkf | | 3,048 | ?? |
| Fort Hunter Liggett | mitigation | US on-site management | DOD | sjkf | | ?? | ?? |

TABLE 2. (continued). Summary of Larger and Community-level Conservation Efforts in the San Joaquin Valley Planning Area.

| Project | Purpose | Location | Mgmt. Agency ¹ | Target Species ² | Other Species | Size (Acres) | Year Acquired |
|----------------------------------|--------------------|-----------------------------------|---------------------------|-----------------------------|------------------------|--------------|---------------|
| Camp Roberts | mitigation | US on-site management | DOD | sjkf | | 40,000 | ?? |
| CEC | mitigation | State on-site management | CEC | sjkf | | 0 | ?? |
| Ca. Aqueduct Em. Op & Mt. '91 | mitigation | Kern Fan Element | DWR | bnll sjas sjkf tkr | | 118 | * |
| Coastal Branch Phase II Pipeline | mitigation | Kern Fan Element | DWR | bnll gkr sjas sjkf | hws sjwt | 1,661 | * |
| CVP San Luis Dam | on-site mitigation | US-O'Neill Forebay Wildli Area | BR | sjkf | | 700 | 1976 |
| CVP San Luis Dam | on-site mitigation | US-San Luis Reservoir Wildl Area | BR | sjkf | | 846 | 1976 |
| O'Neill Dam Safety Project | on-site mitigation | I5 corridor | BR | sjkf | | 171 | 1964 |
| Delano Prison | on-site mitigation | US on-site management | DOC | bnll sjkf tkr | | 348 | 1990 |
| Los Vaqueros Watershed | on-site mitigation | Los Vaqueros Watershed | CCWD | sjkf | | 4,150 | 1994 |
| Unimin | on-site mitigation | Unimin Property | owner? | sjkf | | 50 | ?? |
| Cowell Ranch | on-site mitigation | Cowell Ranch Property | owner? | sjkf | | ?? | ?? |
| Byron Airport | on-site mitigation | Byron Airport Property | owner? | sjkf | | 821 | ?? |
| Ca. Aqueduct Em. Op & Mt. '93 | on-site mitigation | SJ Field Division | DWR | bnll sjkf tkr | | 212 | 1963 |
| Coles Levee Ecological Preserve | mitigation bank | Coles Levee Ecosystem Preserve | CLEP | bnll gkr sjas sjkf tkr | hws | 6,020 | 1993 |
| Tule Vista Farms Conviction | Plea agreement | Pixley NWR | USFWS | bnll sjkf tkr | | 160 | 1994 |
| J. G. Boswell Co. | canceled | Kern Lake Preserve | TNC | bss | bvls | 83 | 1984 |
| Metropolitan Bakersfield HCP | mitigation | Metropolitan Bakersfield | NA | bc hws sjwt bnll sjkf tkr | | 262,000 | NA |
| Kern Co. Valley Floor HCP | mitigation | Kern Co. San Joaquin Valley Floor | NA | undecided | | 1,920,000 | NA |
| Tulare Co. HCP | mitigation | Tulare Co. Valley Floor | NA | | | 1,088,000 | NA |
| Pleasant Valley HCP | mitigation | Pleasant Valley, Fresno Co. | NA | | | 160,000 | NA |
| San Joaquin County HCP | mitigation | San Joaquin Co. | NA | | | | NA |
| CDWR Aqueduct HCP | mitigation | CA Aqueduct in San Joaquin Valley | NA | | | 12,000 | NA |
| Kern Fan Water Bank | on site mitigation | Kern River Fan, W. Kern Co. | CDWR | bnll gkr sjkf tkr | bss hws sjwt bvls sjas | 23,800 | 1990 |
| Celeron All-American Pipeline | mitigation | CPNA | USBLM | bnll, sjkf, gkr | | 140.08 | 1988 |

TABLE 2. (continued). Summary of Larger and Community-level Conservation Efforts in the San Joaquin Valley Planning Area.

| Project | Purpose | Location | Mgmt. Agency ¹ | Target Species ² | Other Species | Size (Acres) | Year Acquired |
|--|---------------|-------------------------------|---------------------------|---------------------------------|---------------|--------------|---------------|
| PG&E UltraPower Ogle Transmission Line | mitigation | CPNA | USBLM | bnll, sjkf | | 30 | 1990 |
| PSE Sierra, Double C and Kern Front Cogen | mitigation | CPNA | USBLM | sjkf | | 137.42 | 1991 |
| Valley Waste BV-2 | mitigation | CPNA | USBLM | bnll, sjkf, gkr | | 88.23 | 1991 |
| So Cal Gas North Midway Sunset Pipeline and Buena Vista Pipeline | mitigation | CPNA | USBLM | bnll, gkr, sjkf | | 228.34 | 1991 |
| Celeron Pentland Pipeline | mitigation | CPNA | USBLM | bnll, sjkf | | 21.33 | 1991 |
| PG&E UltraPower Ogle Gas Line | mitigation | CPNA | USBLM | sjkf, bnll | | 14.86 | 1991 |
| Chalk Cliff ??? | mitigation | CPNA | USBLM | sjkf | | 20.97 | 1991 |
| Mt. Poso Cogen | mitigation | CPNA | USBLM | bnll, sjkf | | 40 | 1993 |
| So Cal Gas South Midway Sunset Pipeline | mitigation | Coles Levy Ecosystem Preserve | ARCO, CDFG | bnll, sjkf | | 5.67 | 1994 |
| LWCF | nonmitigation | CPNA | USBLM | bnll, sjkf, gkr, cff, sjwt, hws | sjas, mopl | 87,123.02 | 1988-95 |
| North Cousins Exchange | nonmitigation | CPNA | USBLM | bnll, sjkf, gkr, cff, sjwt, hws | sjas, mopl | 4,519 | 1989 |
| Goodwin II Exchange | nonmitigation | CPNA | USBLM | bnll, sjkf, gkr, cff, sjwt, hws | sjas, mopl | 6,899 | 1989 |
| Goodwin I Exchange | nonmitigation | CPNA | USBLM | bnll, sjkf, gkr, cff, sjwt, hws | sjas, mopl | 1,200 | 1993 |
| Taft Exchange | nonmitigation | CPNA | USBLM | sjkf, bnll, gkr | | 2,403.15 | 1993-94 |
| Mobil Oil | mitigation | CPNA, BV Valley | USBLM | sjkf, bnll, gkr | | 1,140 | 1992 |

¹ currently under negotiations

² BR—Bureau of Reclamation; USBLM—Bureau of Land Management; CCWD—Contra Costa Water District; CDFD—California Department of Fish & Game; CEC—California Energy Commission; CLEP—Coles Levee Ecosystem Preserve; CNLM—Center for Natural Lands Management; DOC—United States Department of Corrections; DOD—Department of Defense; DWR—Department of Water Resources; CPNA—Carrizo Plain Natural Area; USFWS—U.S. Fish & Wildlife Service; KNWR—Kern National Wildlife Refuge; TNC—The Nature Conservancy

² bc – Bakersfield cactus; bnll – Blunt-nosed leopard lizard; bss – Bakersfield smallscale; bvl – Buena Vista Lake shrew; casb – Cervo aegialian scarab beetle; cff – California jewelflower; cpl – Comanche Point layia; ddw – Doyen's dune weevil; dpcp – Diamond-petaled California poppy; flr – Fresno kangaroo rat; gkr – Giant kangaroo rat; hws – Hoover's woolly-star; jpg – Jared's peppergress; km – Kern mallow; lhb – Lost Hills saltbush; lss – Lesser saltscale; mm – Merced monardella; mp – Merced phacelia; mtt – Munz's tidy-tips; ons – Oil neststraw; pbbs – Palmate-bracted bird's-beak; tp – Tejon poppy; rbr – Riparian brush rabbit; rwr – Riparian woodrat; sjas – San Joaquin antelope squirrel; sjdb – San Joaquin dune beetle; sjkf – San Joaquin kit fox; sjkr – San Joaquin kangaroo rat; sjlt – San Joaquin LeConte's thrasher; sjwt – San Joaquin woolly-threads; snkr – Short-nosed kangaroo rat; tbw – Temblor buckwheat; tgm – Tulare grasshopper mouse; tkr – Tipton kangaroo rat; vc – Vasek's clarkia

by The Nature Conservancy have resulted in about 83 percent of the 102,640 hectares (253,628 acre) Carrizo Plain Natural Area being in public or The Nature Conservancy ownership. Congressional appropriations and Federal land exchanges were used to acquire 26,102 hectares (64,500 acres) between 1988 and 1995 to add to the 54,442 hectares (134,528 acres) already in Federal ownership. These properties are managed by USBLM. The CDFG has management responsibility for the 2,574 hectares (6,360 acres) the State has purchased, and The Nature Conservancy owns and manages another 2,577 hectares (6,369 acres). The Carrizo Plain Natural Area is a relatively large area, but thousands of acres were farmed for decades and a large proportion is steep, mountainous terrain; less than about 30 percent provided natural habitat for listed species at the time of establishment.

Another large scale program of acquisition, directed by USBLM, is the land purchases and exchange in the western Fresno and eastern San Benito Counties, mainly involving properties known as the Martin or Cantua Creek and Silver Creek ranches (hereinafter called the *Ciervo-Panoche Natural Area*). Acquisitions in these two programs (Carrizo Plain Natural Area and Ciervo-Panoche Natural Area) collectively have done more to advance the recovery of the San Joaquin Valley's listed species than all others combined. Acquisition will continue to be a major element of recovery processes, but will play a lesser role than in the past.

The third large-scale program by the Federal government has been the acquisition of fee title and easements to natural and farmlands in Stanislaus and Merced Counties to add to existing and create new National Wildlife Refuges. This program has been directed at waterfowl and other wetland species though substantial areas in Merced County are upland communities. With some change in management objectives and habitat restoration, upland areas could support a significantly larger population of kit foxes than currently. Easement lands support a small population of San Joaquin kangaroo rats with a unique genetic constitution, though its subspecies taxonomy is unclear (Johnson and Clifton 1992, Endangered Species Recovery Program unpubl. data). In both counties some riparian areas on existing and planned refuge lands could provide habitat for viable populations of riparian brush rabbits and woodrats.

Additions to the Pixley National Wildlife Refuge, Tulare County, have provided significant habitat for

blunt-nosed leopard lizards, Tipton kangaroo rats, San Joaquin kit foxes, and mountain plovers (a candidate species not featured in this plan, but a large proportion of its total population winters in the area covered in this plan). Addition of the Bitter Creek National Wildlife Refuge (foothills and mountains at southwestern edge of the Valley, mostly in Kern County) to the Hopper Mountain refuge complex, though targeted for recovery of the California condor, provides some habitat for the San Joaquin kit fox, San Joaquin antelope squirrel, Tulare grasshopper mouse, and possibly the blunt-nosed leopard lizard, giant and short-nosed kangaroo rats, mountain plover, and San Joaquin LeConte's thrasher.

Acquisition of properties in the Allensworth Natural Area of Tulare and Kern Counties and the Semitropic Ridge and Lokern Natural Areas [natural areas defined by Spiegel and Anderson (1992) and being developed by CDFG, California Energy Commission, and Center for Natural Lands Management have been from a variety of funds, both public and private (Table 2). To date, the conservation parcels are relatively small and scattered, but each of the three areas are critical to the recovery of some species. Dedicated conservation lands in each area should expand as the Habitat Conservation Plans for the Valley floor portions of Tulare and Kern Counties are completed and implemented, and if the ongoing planning for a mitigation bank in the Lokern Natural Area by the agencies and Chevron, Inc., is completed and a mitigation bank established.

Several agency management plans and management agreements, which define and commit an agency to managing property in specified ways, exist or are being developed to protect listed species habitat in the San Joaquin Valley. The primary goal of these plans is to ensure that properties with value as habitat for listed species are managed and monitored to preserve, protect, or enhance populations of those species while protecting other societal interests. Plans of this sort represent the principal mechanism for protecting listed species on public lands. Common shortcomings, however, of these plans are lack of adequate information on which to base habitat management actions, and few or no provisions for obtaining needed information. The exceptions are several recently-developed plans that make provisions to conduct research as high priorities (e.g., Center for Natural Lands Management in litt. 1993, USBLM et al. in litt. 1995).

Critical Needs Analysis.—The status of 32 of the 34 species included in this recovery plan was examined for

critical needs as part of the Friant Biological Opinion Critical Needs Analysis (Colliver et al. 1995). Additional species of the Sierra foothills also were included in the analysis, but are not discussed here. The other two species of this recovery plan, the San Joaquin kit fox and the palmate-bracted bird's-beak, were not included, by agreement with the USFWS, because they were dealt with in the critical needs analysis for the contemporaneous Biological Opinion for Interim Contract Renewal (USFWS in litt. 1995a). That analysis found that both the San Joaquin kit fox and palmate-bracted bird's-beak had critical needs.

Of the 34 species examined in the two analyses, 12 have critical needs. These species are: palmate-bracted bird's beak, Kern mallow, Bakersfield cactus, Bakersfield smallscale, Vasek's clarkia, oil neststraw, Fresno kangaroo rat, riparian woodrat, Buena Vista Lake shrew, riparian brush rabbit, San Joaquin kit fox, and Doyen's dune weevil. A critical need is defined as any intrinsic state or external situation that threatens a species with extinction or preclusion of recovery and requires action during the next year to improve or avoid a further deterioration of that species' chances of survival and recovery. The critical threats and actions needed for each of the 12 species are reflected in the recovery tasks and priorities established in this recovery plan for these species.

4. Ecosystem-Level Recovery Strategy

Approach to Recovery Planning.—As with many other Federal land-management agencies, the USFWS has adopted an ecosystem approach in managing our Nation's natural resources (USFWS 1994b, Henne 1995, USFWS in litt. 1995b). Given the increasingly severe constraints — environmental, financial, temporal, political, practical, and other — of single-species conservation efforts, consideration of a broader, ecosystem approach to conservation has gained much wider attention in recent years (Salwasser 1991, Costanza et al. 1992, Grumbine 1992, Franklin 1993, Jensen et al. 1993, Scott et al. 1993, Slocombe 1993, Tasse 1993, Wilcove 1993, Alverson et al. 1994, Bormann et al. 1994, Grumbine 1994a, 1994b, Jensen and Bourgeron 1994, Noss and Cooperrider 1994, Soule 1994, Alpert 1995, Ecological Society of America 1995a, 1995b, Kerr 1995, Keystone Center 1991, National Research Council in litt. 1995, Noss et al. 1995, Pastor 1995, Tear et al. 1995, Walker 1995, Yaffee et al. 1996).

The ecosystem approach is not, however, without problems and critics (LaRoe 1993, Eisner et al. 1995, Stanley 1995, Wilcove and Blair 1995). Although the ecosystem approach suggests a more simplistic and holistic process for conserving listed species, this approach must still attend to the management and monitoring requirements of key species in the ecosystem to ensure that the ecosystem maintains its integrity — its constituent species and dynamics — and continues to support those species that are most vulnerable to ecosystem change. Though there indeed are many advantages to an ecosystem approach, both the State and Federal endangered species acts still require recovery of individually listed species.

In concert with the evolution of the ecosystem management paradigm, *adaptive management* has become a somewhat common theme in the conservation literature (Holling 1978, Lee and Lawrence 1986, Walters 1986, Walters and Holling 1990, Boyce 1992 and 1993, Noss and Cooperrider 1994). Adaptive management is the “process of linking management with monitoring within a research framework” (Noss and Cooperrider 1994, p. 298). It is learning by doing, and ongoing monitoring and research are essential to learning how to efficiently and sensitively manage ecosystems. Such research will include *population viability analyses* of key species—umbrella (listed species with the broadest geographic ranges and habitat requirements), keystone (those which by their numbers or activities have key roles in shaping the species composition or physical structure of the natural community), and indicator (species whose presence symbolizes certain features of a natural community). Boyce (1992, 1993, p. 525) considers such analyses, if done properly, a natural extension of adaptive management. Population viability analyses require that all available data on a target species be pulled together to build a simulation model, a model that constitutes a synthesis of our current understanding of the target species population. Population viability analyses can then be used to develop hypotheses about how a particular environmental perturbation (e.g. flood, fire) or a new management scenario would affect a target species population. In this way, population viability analyses can guide the direction of management. This approach is necessary for recovery of some key species in the San Joaquin Valley.

The planning area addressed in this recovery plan (Figure 4; key to numbered locations is in Table 3)—the San Joaquin Valley, Carrizo and Elkhorn Plains, and

Figure 4 Planning area, showing public and conservation lands. GOES HERE—IT IS A 11X17 FOLDOUT MAP-BLANK ON BACK SIDE

(back side of Figure 4)

TABLE 3. KEY TO PUBLIC AND CONSERVATION LAND PARCELS SHOWN IN FIGURE 4.

| Name | Map Number |
|--|-------------------|
| Acker Island | 1 |
| Alkali Sink Ecological Reserve | 2 |
| Allensworth Ecological Reserve | 3 |
| Antioch Dunes National Wildlife Refuge | 4 |
| Banta-Carbona Fish Screen | 5 |
| Barker Slough | 6 |
| Bitter Creek National Wildlife Refuge | 7 |
| Brannon Island Fishing Access | 8 |
| Buttonwillow (CDFG) | 9 |
| Calhoun Cut Ecological Reserve | 10 |
| Camp Roberts Military Reserve | 11 |
| Carrizo Plains Ecological Reserve | 12 |
| Caswell Memorial | 13 |
| China Island | 14 |
| Chowchilla Canal Bypass | 15 |
| Claus | 16 |
| Clifton Court Forebay Wildlife Area | 17 |
| Coles Levee | 18 |
| Consumnes River | 19 |
| Corral Hollow Ecological Reserve | 20 |
| Cottonwood Creek (Upper & Lower) | 21 |
| Creighton Ranch Preserve | 22 |
| Delta Islands | 23 |
| Delta Meadows | 24 |
| Dos Amigos Mitigation Area | 25 |
| Duck Creek Conservation Easement | 26 |
| Duck Pond | 27 |
| East Gallo | 28 |
| Elk Hills | 29 |
| Elkhorn Plains Ecological Reserve | 30 |
| Flying M Ranch | 31 |
| Freitas | 32 |
| Fresno River | 33 |
| Goose Lake | 34 |
| Grasslands State Park | 35 |
| Grayson-San Joaquin River Cone | 36 |
| Grizzly Island | 37 |
| Hailwood | 38 |
| Hill Slough Wildlife Area | 39 |
| Hunter Liggett Military Reserve | 40 |
| Jepson Prairie | 41 |
| Kaweah Oaks Preserve | 42 |
| Kelly | 43 |
| Kerman Ecological Reserve | 44 |
| Kern National Wildlife Refuge | 45 |
| Kern River Parkway | 46 |
| Kesterson National Wildlife Refuge | 47 |

TABLE 3. (continued). Key to Public and Conservation Land Parcels Shown in Figure 4.

| Name | Map Number |
|--|-------------------|
| Kesterson Site | 48 |
| Le Grand | 49 |
| Lemoore Naval Air Station | 50 |
| Little Panoche Reservoir Wildlife Area | 51 |
| Lokern Preserve | 52 |
| Los Banos Wildlife Management Area | 53 |
| Los Vaqueros Conservation Easement | 54 |
| Lost Slough | 55 |
| Mendota Wildlife Management Area | 56 |
| Merced National Wildlife Refuge | 57 |
| Merced River Fish Facility | 58 |
| Mount Diablo State Park | 59 |
| Northern Semi-Tropic Ridge | 60 |
| O' Neill Forebay Wildlife Management Area | 61 |
| Paine Preserve | 62 |
| Panoche Hills Ecological Reserve | 63 |
| Pilibos Mitigation Area | 64 |
| Pixley National Wildlife Refuge | 65 |
| Pixley National Wildlife Refuge | 66 |
| Pixley Vernal Pools Preserve | 67 |
| Pleasant Valley | 68 |
| Poso Creek Conservation Easement | 69 |
| Rhode Island Delta Riparian Habitat | 70 |
| Salt Slough | 71 |
| Salt Spring Conservation Easement | 72 |
| San Joaquin River National Wildlife Refuge | 73 |
| San Joaquin Ecological Reserve | 74 |
| San Luis Canal Mitigation Area | 75 |
| San Luis National Wildlife Refuge | 76 |
| San Luis Reservoir Wildlife Area | 77 |
| Sandridge Preserve | 78 |
| Schwab | 79 |
| Semi-Tropic Ridge | 80 |
| Sherman Island Waterfowl Management Area | 81 |
| Stanislaus River (Lower) | 82 |
| Stone Corral | 83 |
| Sycamore Island Conservation Easement | 84 |
| Tracy Hills | 85 |
| Tule Elk State Reserve | 86 |
| Vernalis Riparian Habitat Corridor | 87 |
| Volta Wildlife Management Area | 88 |
| West Gallo | 89 |
| White Slough Wildlife Management Area | 90 |
| White Slough Wildlife Management Area | 91 |
| Woodbridge Ecological Reserve | 92 |
| Yaudanchi Ecological Refuge | 93 |
| Yolo Basin Conservation Easement | 94 |

parts of the Cuyama, Salinas, Sacramento, and other valleys—is a “focus area” in the USFWS Central Valley of California/San Francisco Bay and South Pacific Coast ecosystem units (USFWS in litt. 1995*b*). However, this focus area differs in a number of significant ways from lands addressed in other ecosystem-level conservation efforts. Those efforts generally involve millions of acres of publicly-owned lands, often with large expanses of wilderness (e.g., Clark and Zaunbrecher 1987, Everett et al. 1994).

Of the 45,477 square kilometers (17,539 square miles) in the planning area, exclusive of the Salinas and Pajaro watersheds, only about 2,574 square kilometers (994 square miles) are in public and conservation ownership, about 5.7 percent. This contrasts dramatically with other ecosystem efforts throughout the west and with land ownership in other parts of California. The San Joaquin Valley has much more land in private ownership than any of California’s nine other bioregions. Most of the landscape, 95 percent or more, has been altered from its natural state and replaced by irrigated agriculture, cities and towns, and industrial developments. Within this human-shaped mosaic are sparsely scattered remnants of natural communities, all of which

have been severely degraded, altered, and fragmented by human activities. One of the most basic and prominent of ecosystem features on the San Joaquin Valley floor—seasonal flooding by winter storms and snowmelt in the towering Sierra Nevada—has been nearly eliminated by the dams, reservoirs, pumps, diversion channels, and canals that capture its waters for use by agriculture and municipalities, some outside its boundaries. All the natural communities shaped and maintained by seasonal runoff no longer function normally, which has led to their endangerment.

This recovery plan acknowledges that if recovery is to be achieved, it must take place within the constraints of the existing human-dominated ecosystem. Trust, partnership, and common purpose must be established amongst government agencies, ranchers, farmers, developers, conservationists, urbanites, and other citizens of the Valley.

If implemented, the outcome of this planning effort most probably will retain the advantages of ecosystem-level conservation: involving all segments of society in recovery actions; preserving all or most species simultaneously; saving effort and money; and increasing the chances that recovery efforts will succeed.

